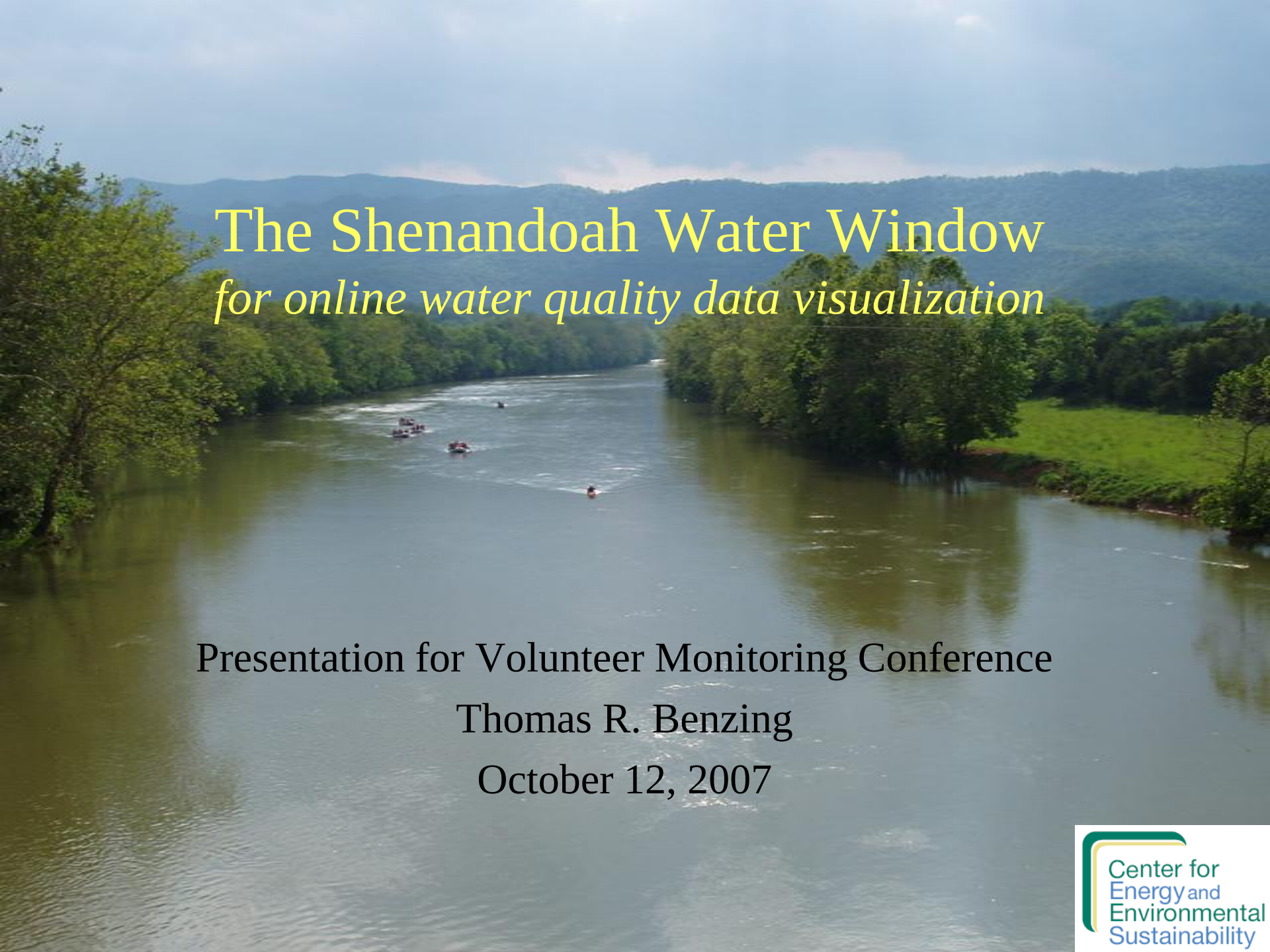


The Shenandoah Water Window

for online water quality data visualization

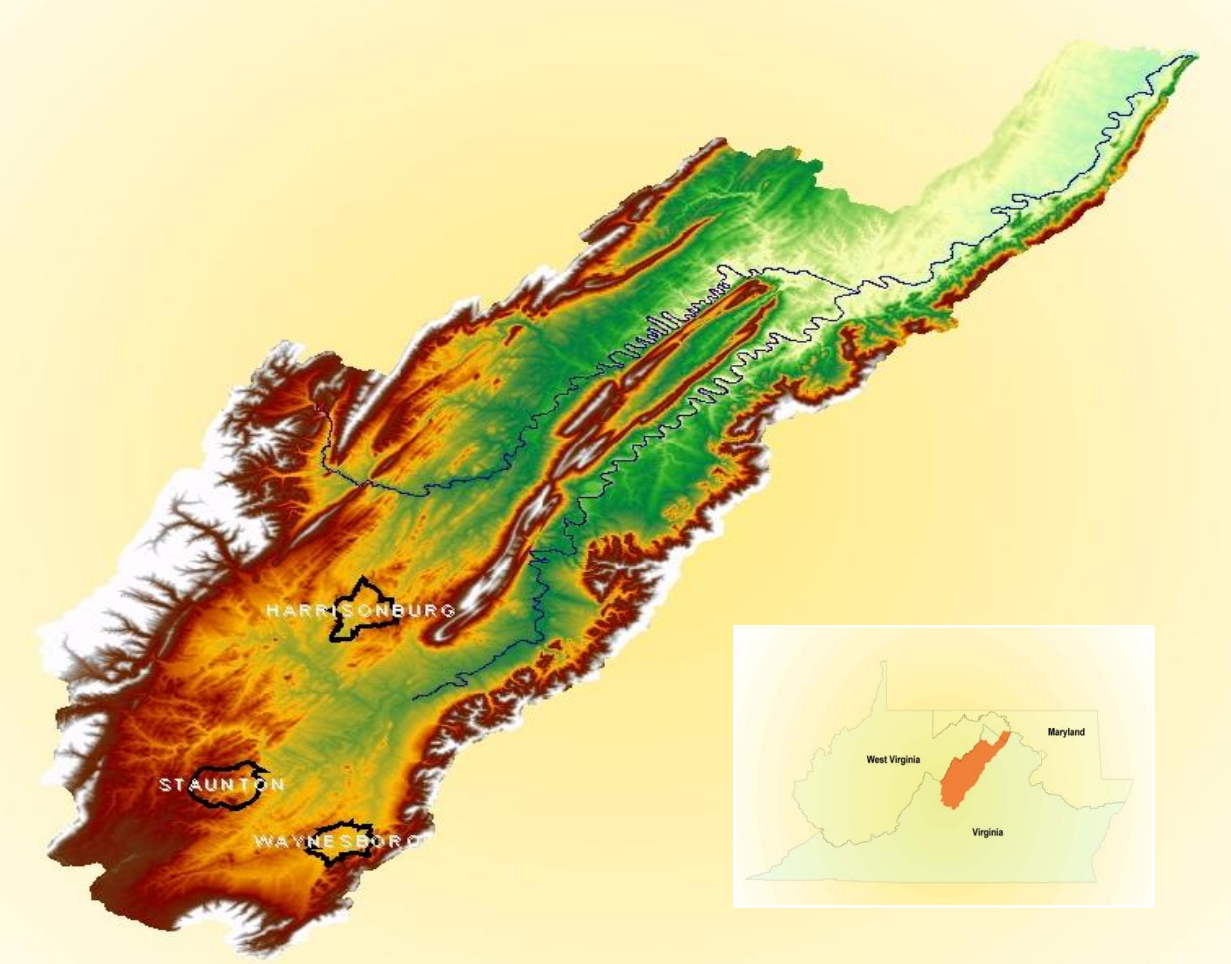
Presentation for Volunteer Monitoring Conference

Thomas R. Benzing

October 12, 2007

Center for Energy and Environmental Sustainability

The Shenandoah River Watershed



Facts:

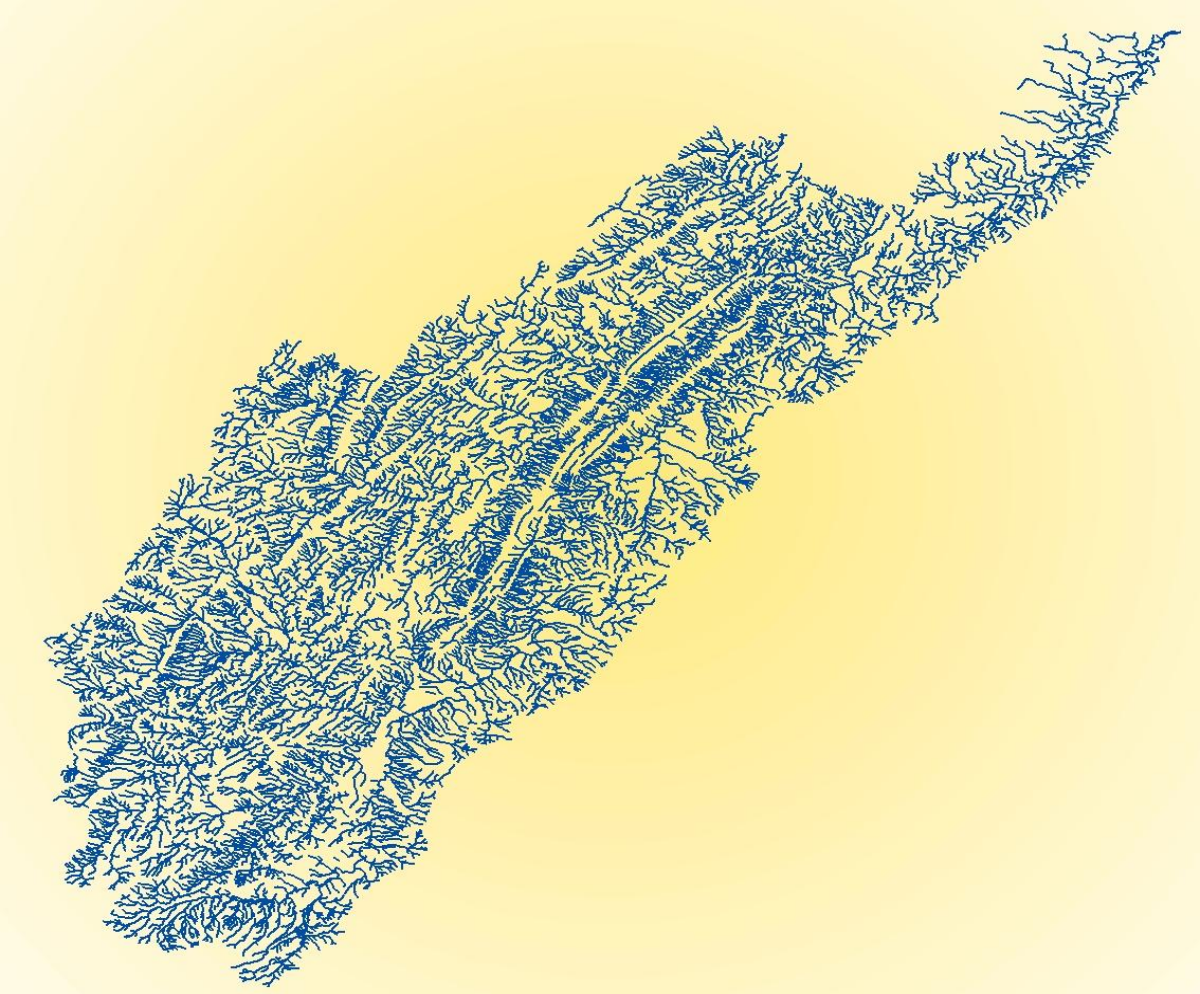
- 3,055 square miles

- The water flows “down the valley”, towards confluence with Potomac River at Harpers Ferry

-7 VA Counties

-2 WV Counties

The Shenandoah River and its Tributaries



Facts:

- Over 7,200 miles of streams

- Average Stream Density: 2.4 mi/mi^2

Friends of the Shenandoah River

"The Friends of the Shenandoah River is a volunteer, non-profit, scientific organization dedicated to the preservation and protection of the Shenandoah River watershed and its tributaries."

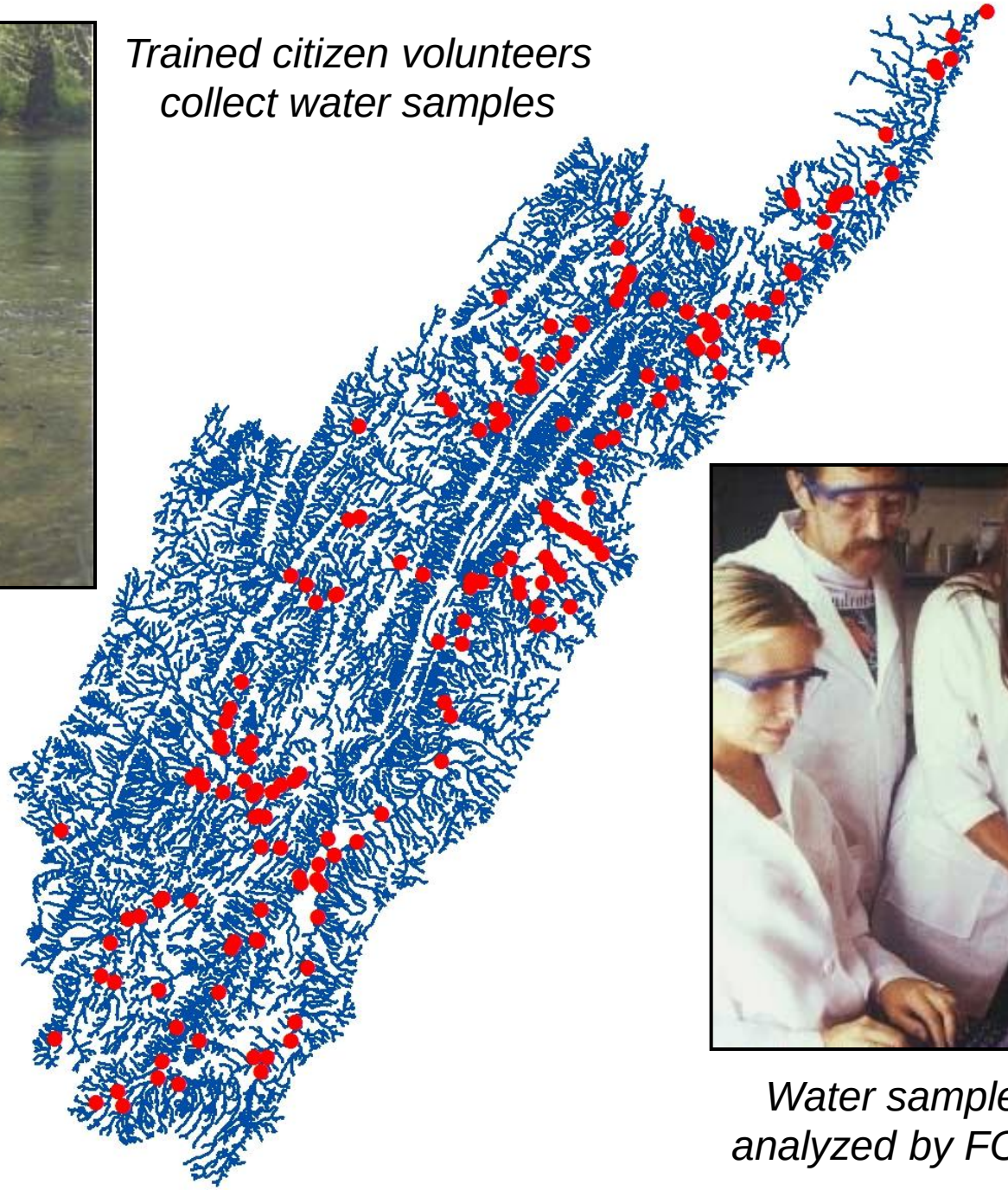
- Since 1995, FSR and its volunteers have collected data twice a month at over 200 locations in the Valley.

•Measurements include:

- Nitrate/Nitrite
- Ammonia
- Orthophosphate
- pH
- Turbidity
- Dissolved Oxygen
- Temperature
- Site Observations

Source of quote and logo is www.fosr.org

Trained citizen volunteers collect water samples



Water samples are analyzed by FOSR lab

The Water Quality Data

Water Quality Database				
SiteID	***Date***	***Nitrate/ Nitrite***	***Orthophosphate***	***pH***
FP11	19960211	1.21	0.01	7.14
GA01	19971215	2.01	0.01	7.24
JR04	19960211	2.10	0.01	7.31
NS02	19991013	0.91	0.02	7.22
FC16	20000320	1.13	0.02	6.29
GA01	20020803	1.02	0.02	7.38

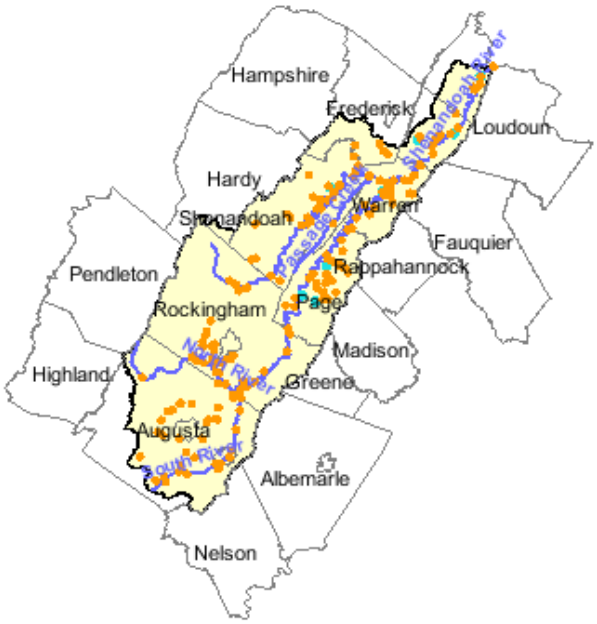
Note: These are only example tables to show general structure of the data

SHENANDOAH VALLEY PURE H2O FORUM

www.purewaterforum.org/waterwindow

The Shenandoah Water Quality Online GIS Interface - Microsoft Internet Explorer

File Edit View Favorites Tools Help Links



Quick Search: Find a Site by entering the SiteID

SiteID [ ] Find the Site See the list

Land Cover Information Viewer

Please select a sampling site...

Water Quality Viewer

Please select a sampling site...

Map Controls

Choose a control and click the map.

Update Map Clear Map Zoom to watershed Help

Map Layers

Select and deselect layers and then click **Update Map** button. *May not be visible at certain map scales

Sampling Sites	Roads	Counties
Outfall sites	Major Roads	Watersheds
Streams *	Towns *	Hillshaded Elevation
Rivers	Shenandoah Basin *	Topographic Map *

Choose what you would like to graph and then push **Graph it!**

Graph: Graph It!

From: See Data

To: Learn more

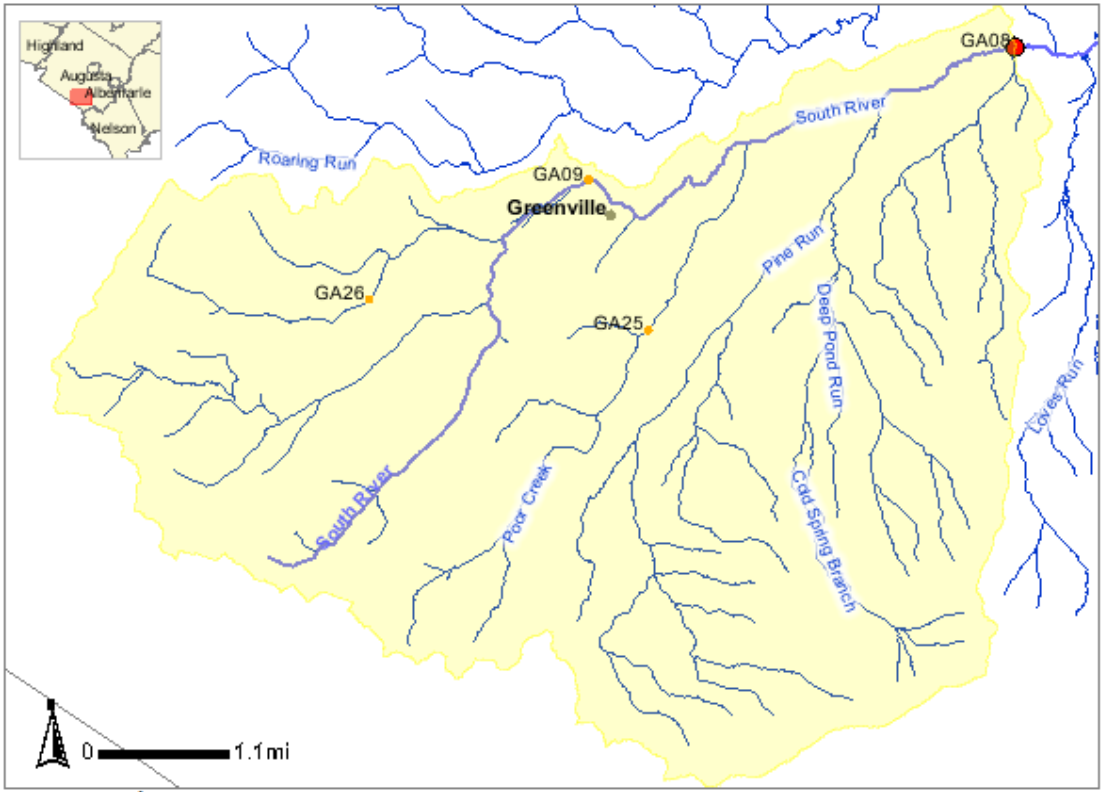
Print

Done Internet

The Shenandoah Water Quality Online GIS Interface - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://cheat.canaanvi.org/swq/main.aspx



Map Controls

Choose a control and click the map.

Update Map | Clear Map | Zoom to Watershed | Help

Map Layers

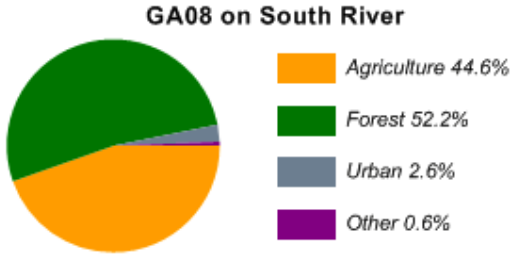
Select and deselect layers and then click **Update Map** button. *May not be visible at certain map scales

Sampling Sites	Roads *	Counties	
Outfall Sites	Major Roads	Watersheds	
Streams *	Towns *	Hillshaded Elevation	
Rivers	Shenandoah Basin *	Topographic Map *	

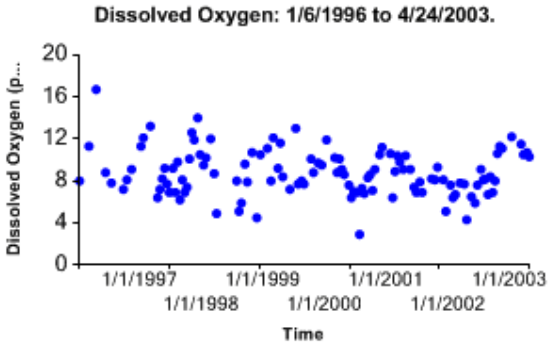
Quick Search: Find a Site by entering the SiteID

SiteID GA08 Find the Site See the List

Land Cover Information Viewer



Water Quality Viewer



Choose what you would like to graph and then push **Graph it!**

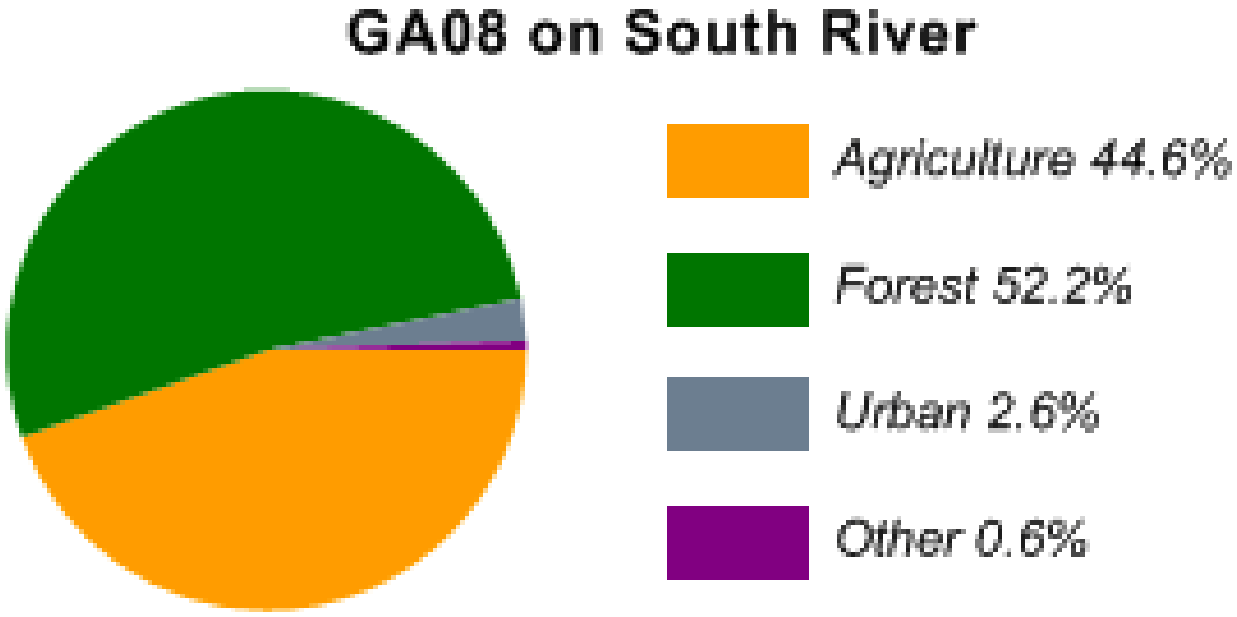
Graph: Dissolved Oxygen — Graph It!

From: Jan 6 1996 — See Data

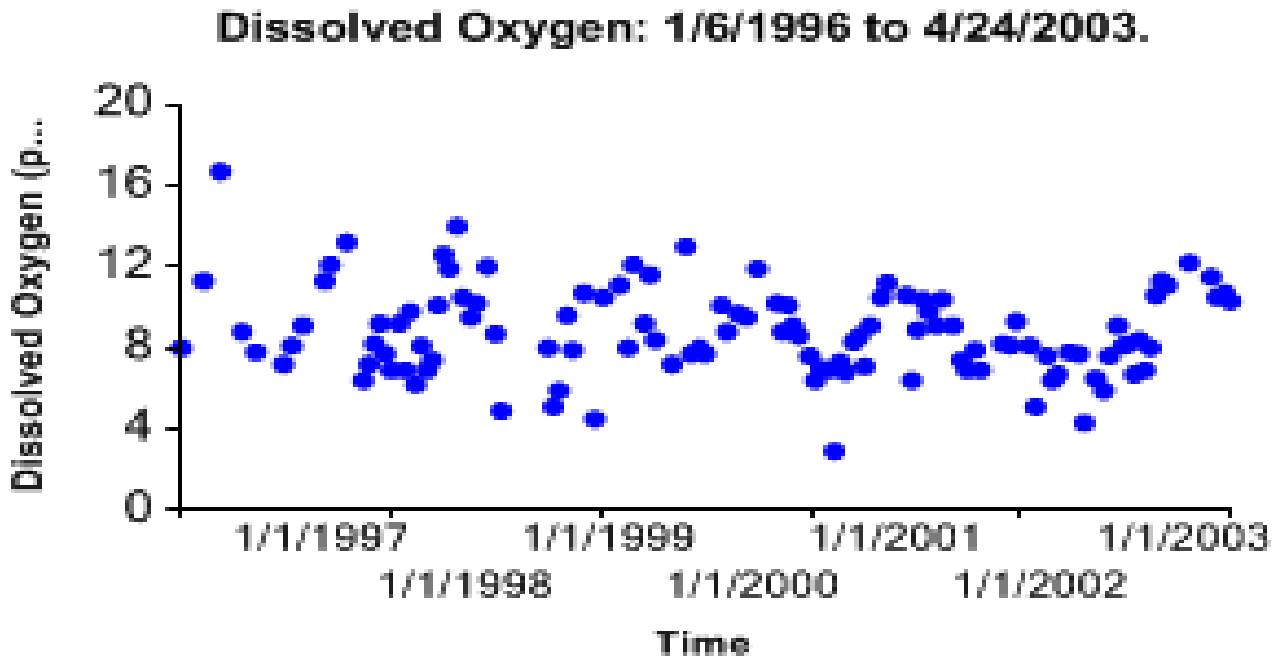
To: Apr 24 2003 — Learn More

Print

Done


GA08 on South River
Agriculture 44.6%
Forest 52.2%
Urban 2.6%
Other 0.6%

Water Quality Viewer



Choose what you would like to graph and then push **Graph it!**

Graph: Dissolved Oxygen — Graph It!

From: Jan 6 1996 — See Data

To: Apr 24 2003 — Learn More

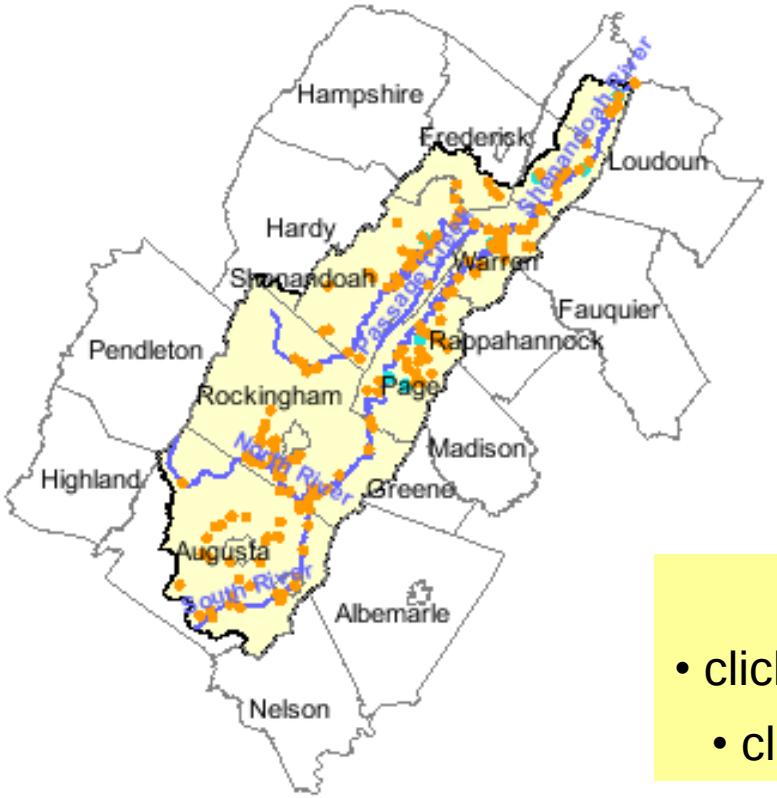
Print

Allows you to download a .csv file with all data

Provides text explaining each parameter

Map Controls

- Zoom In
- Zoom Out
- Re-center
- Select a sampling site
- Update map
- Clear map
- Zoom to watershed
- HELP



Map Layers

- click on box to select
- click Update Map

0 29.4mi

Map Controls

Choose a control and click the map.

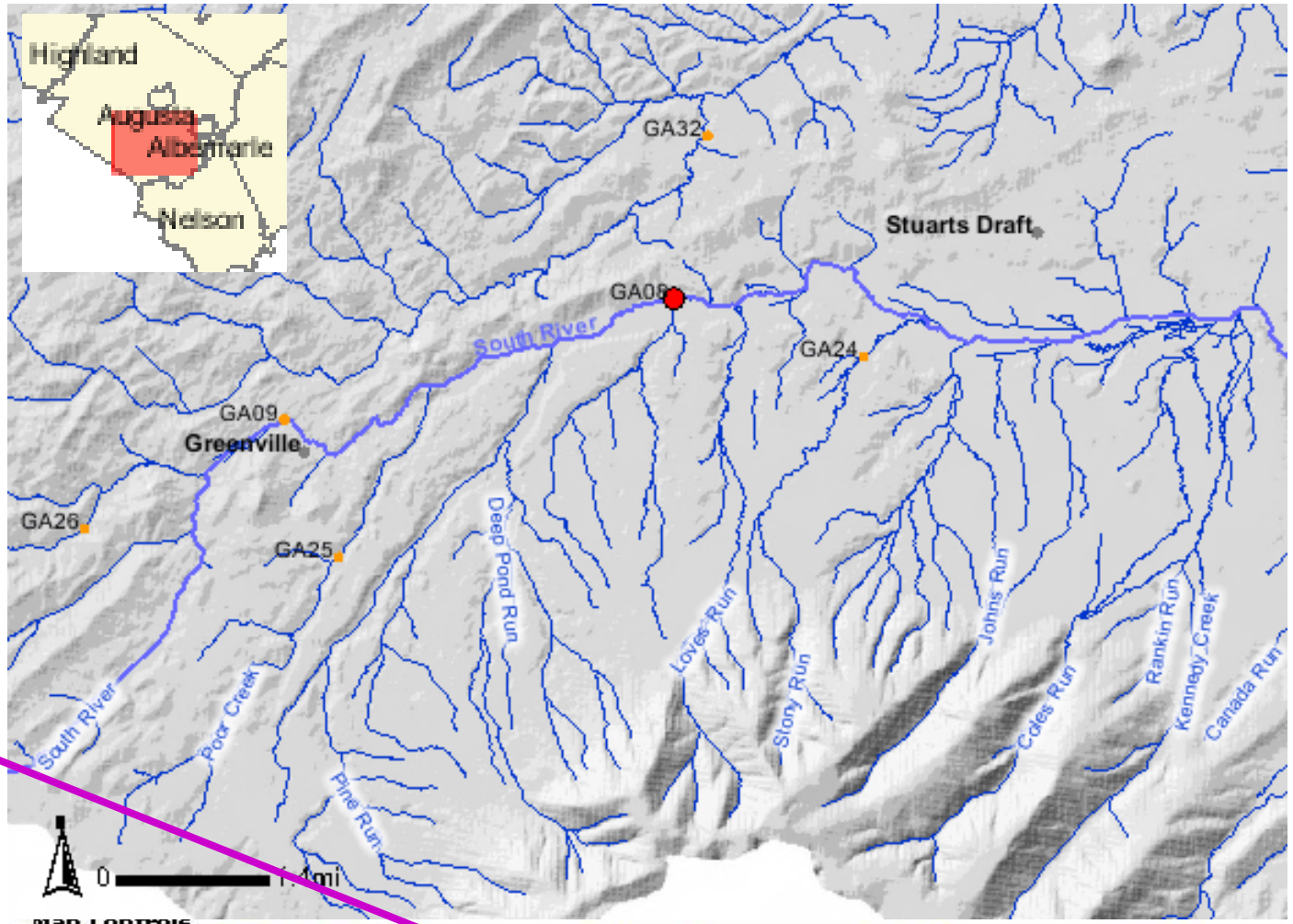
Update Map | Clear Map | Zoom to watershed | Help

Map Layers

Select and deselect layers and then click **Update Map** button. *May not be visible at certain map scales

Sampling Sites	Roads	Counties
Outfall sites	Major Roads	Watersheds
Streams *	Towns *	Hillshaded Elevation
Rivers	Shenandoah Basin *	Topographic Map *

Use to select sampling site



Map Controls

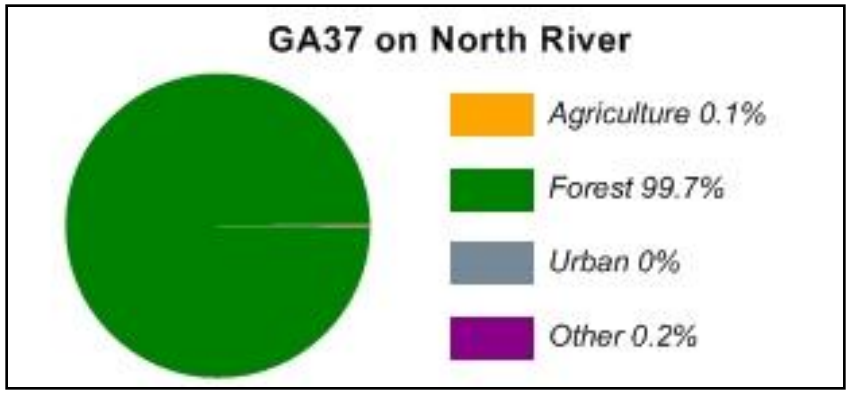
Choose a control and click the map.

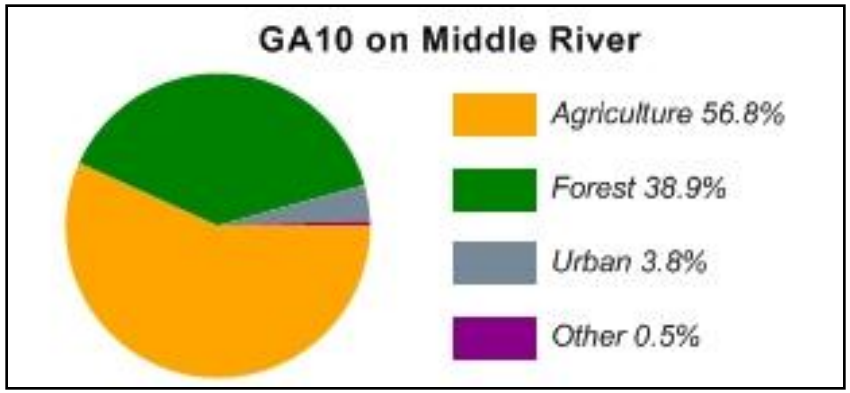
Update Map | Clear Map | Zoom to watershed | Help

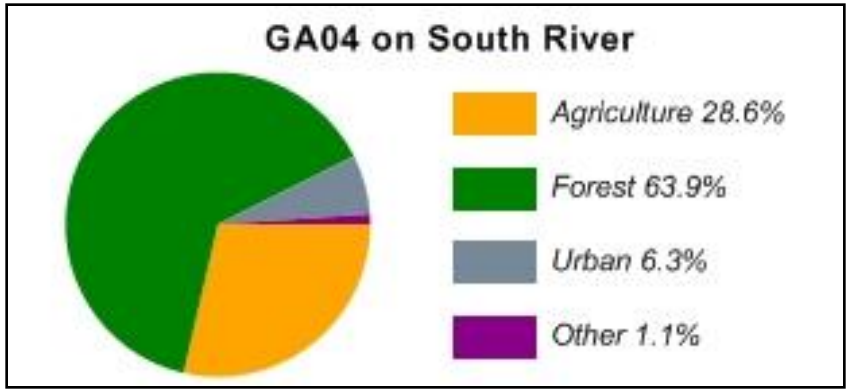
Map Layers

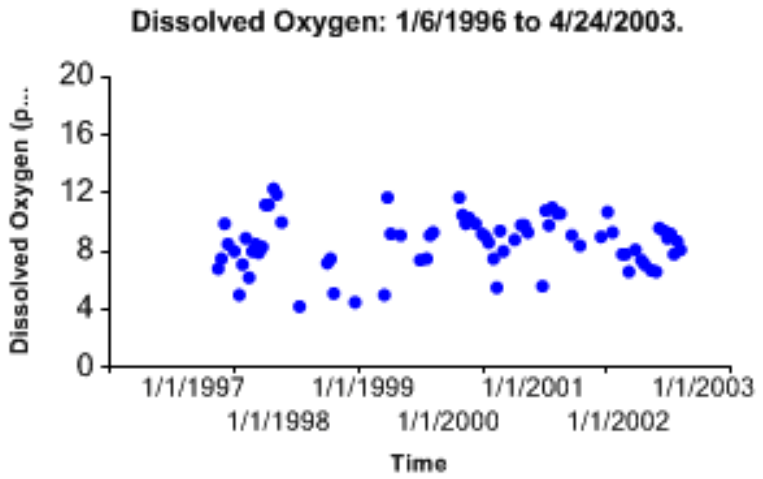
Select and deselect layers and then click **Update Map** button. *May not be visible at certain map scales

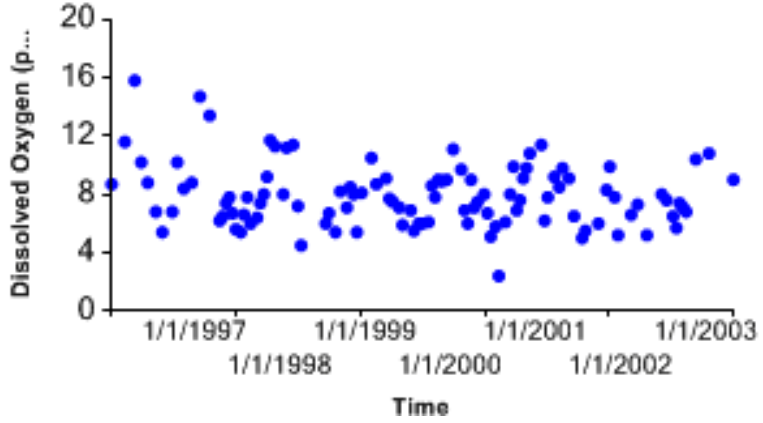
Sampling Sites	Roads	Counties
Outfall sites	Major Roads	Watersheds
Streams *	Towns *	Hillshaded Elevation
Rivers	Shenandoah Basin *	Topographic Map *

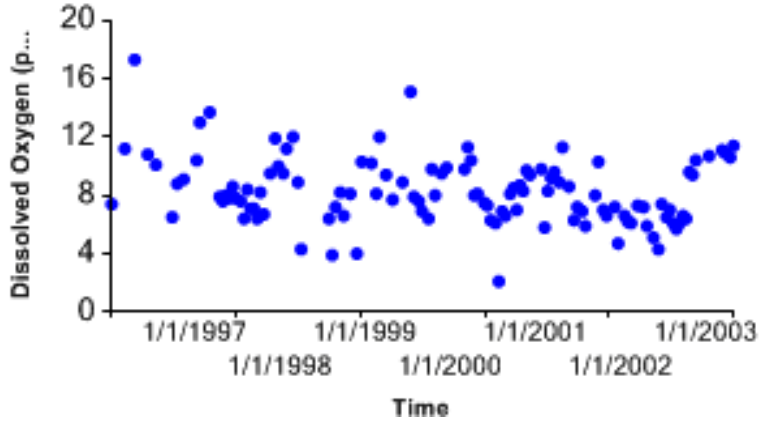

GA37 on North River
Agriculture 0.1%
Forest 99.7%
Urban 0%
Other 0.2%

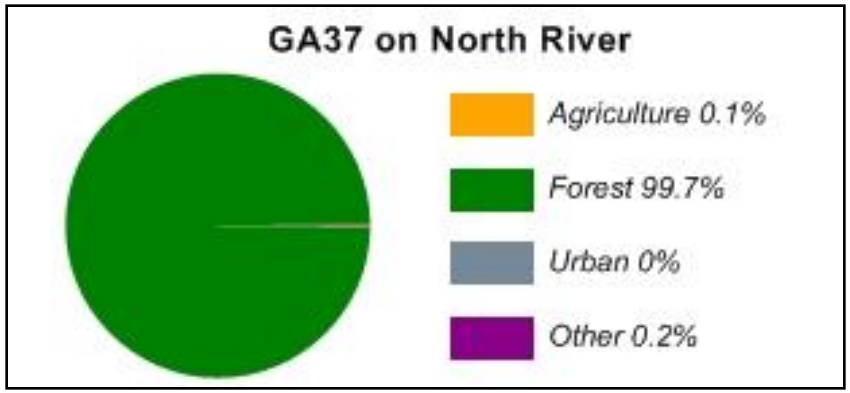

GA10 on Middle River
Agriculture 56.8%
Forest 38.9%
Urban 3.8%
Other 0.5%

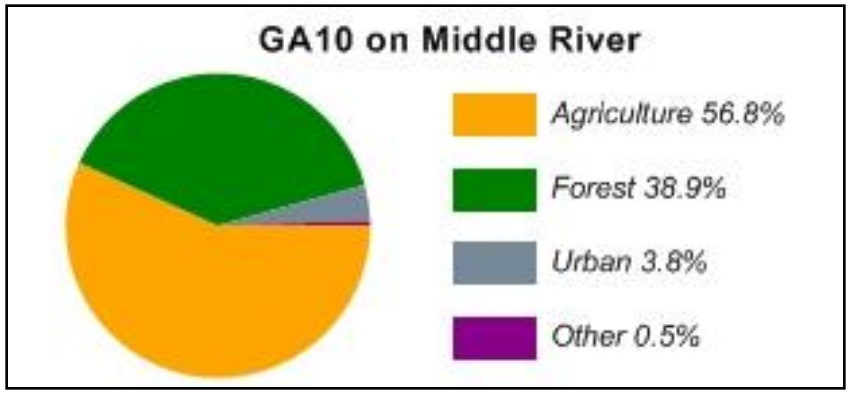

GA04 on South River
Agriculture 28.6%
Forest 63.9%
Urban 6.3%
Other 1.1%

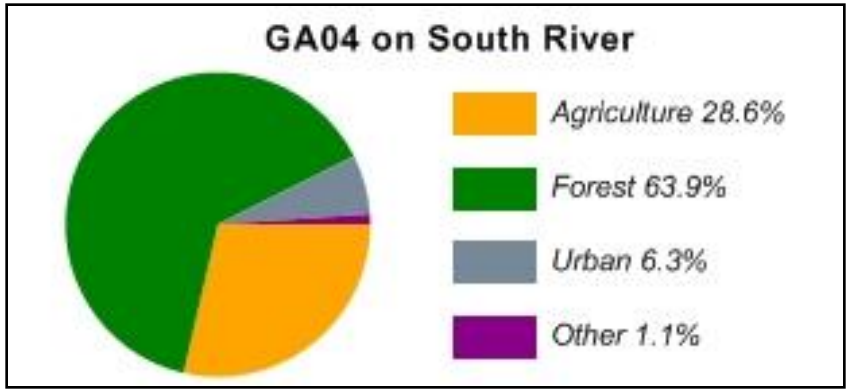

Dissolved Oxygen: 1/6/1996 to 4/24/2003.
Dissolved Oxygen (p...
20
16
12
8
4
0
1/1/1997
1/1/1998
1/1/1999
1/1/2000
1/1/2001
1/1/2002
1/1/2003
Time


Dissolved Oxygen (p...
20
16
12
8
4
0
1/1/1997
1/1/1998
1/1/1999
1/1/2000
1/1/2001
1/1/2002
1/1/2003
Time


Dissolved Oxygen (p...
20
16
12
8
4
0
1/1/1997
1/1/1998
1/1/1999
1/1/2000
1/1/2001
1/1/2002
1/1/2003
Time


GA37 on North River
Agriculture 0.1%
Forest 99.7%
Urban 0%
Other 0.2%


GA10 on Middle River
Agriculture 56.8%
Forest 38.9%
Urban 3.8%
Other 0.5%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Agriculture 28.6%
Forest 63.9%
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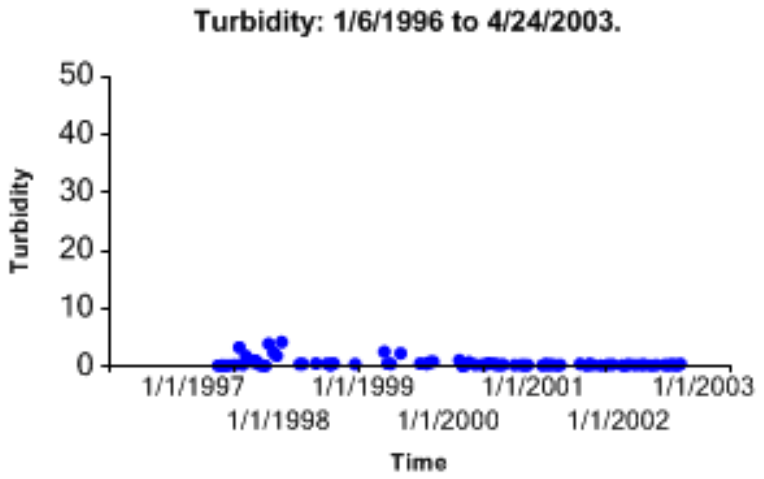
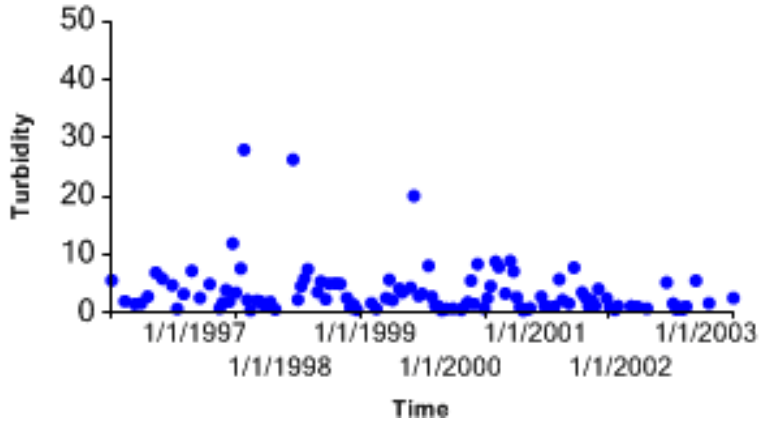
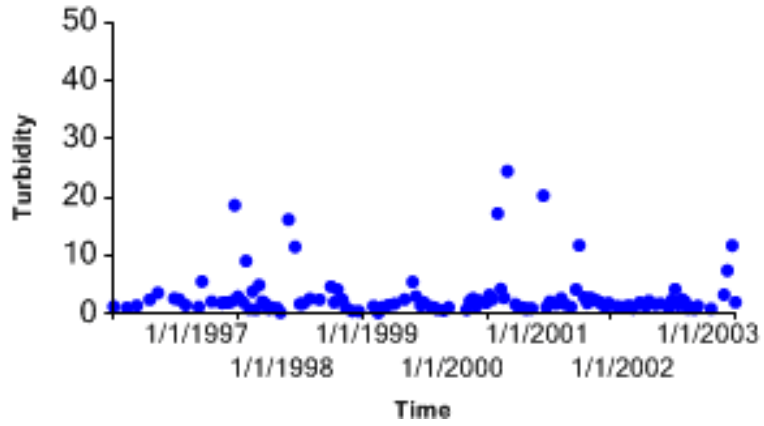

Turbidity: 1/6/1996 to 4/24/2003.
Turbidity
50
40
30
20
10
0
1/1/1997
1/1/1998
1/1/1999
1/1/2000
1/1/2001
1/1/2002
1/1/2003
Time


Turbidity
50
40
30
20
10
0
1/1/1997
1/1/1998
1/1/1999
1/1/2000
1/1/2001
1/1/2002
1/1/2003
Time


Turbidity
50
40
30
20
10
0
1/1/1997
1/1/1998
1/1/1999
1/1/2000
1/1/2001
1/1/2002
1/1/2003
Time

Timeline

Summer/Fall 2002	Kai Degner develops GIS during CVI internship
Winter/Spring 2003	Tom Benzing + Kai conduct “GIS Roadshow”
Summer/Fall 2003	TerraLogic writes code for Water Window
Winter 2004	Water Window goes public on Forum website
Summer 2004 - Fall 2006	Water Window is hosted on CVI server
December 2006	Forum receives computer code from CVI
Winter/Spring 2007	JMU sets up server and software to host WW
Summer/Fall 2007	JMU/Site Vision debug code for new software

Water Window “architecture”

- MS SQL Server queries the water quality database
- Dundas Charts creates the images (pie charts and graphs)
- Arc IMS manages the map layers and creates map images
- Visual Basic . NET assembles the images into webpage
- MS Windows IIS serves the webpage(s) to the client(s)

How has it been used?

- In the first month of its public release (Jan '04), traffic to the Forum website tripled
- During August 2004 – July 2005, over 42,000 images were created on the server at Canaan Valley Institute
- Kai's thesis has been requested by several consulting firms who are interested in creating their own WW

Thanks to

- Friends of the Shenandoah River
- Canaan Valley Institute
- Shenandoah Valley Pure Water Forum
- James Madison University
- Terralogic, Inc
- Site Vision
- Volunteer monitors up and down Shenandoah Valley!

Special thanks to..

- Matt Sherald, CVI
- Don Kemlage, CVI
- Paul Kinder, CVI
- Steve Talley, CVI
- Kai Degner, JMU
- Tim Dewland, JMU
- Scott Arnett, JMU
- Paul Shettel, JMU
- Karen Andersen, FOSR
- Dan Shaffer, Terralogic

Cecily Kihn, Agua Fund
Pat Munoz, SBP
Jay Gilliam, SBP
Stacey Brown, VASOS
Jerry Benson, JMU
Lanny Burt, JMU
Rob Bonfiglio, JMU
Pat Maddox, SiteVision
Mike Haggerty, SiteVision
Bruce Lundeen, PWF